

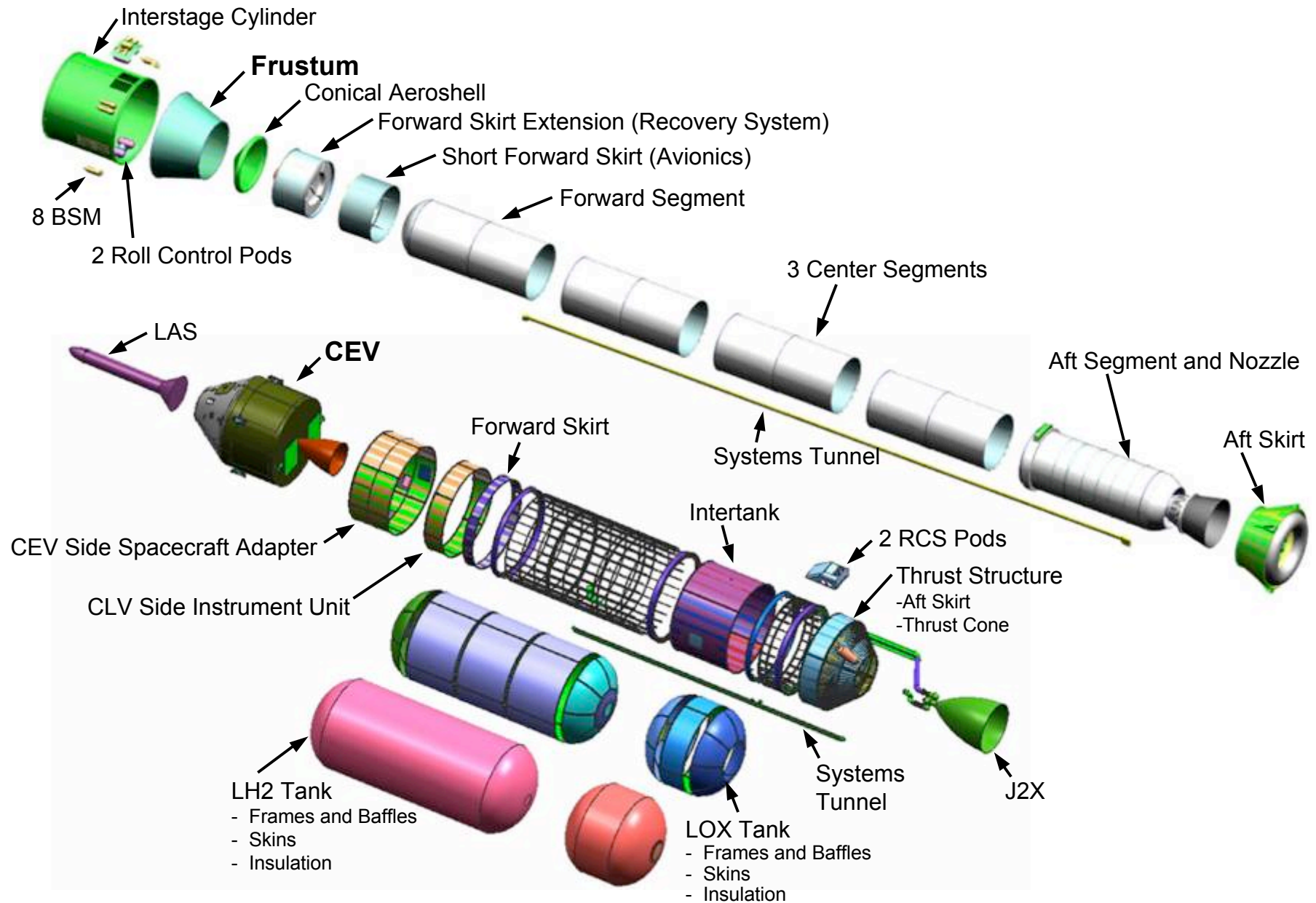
MATERIAL NEED PROJECTIONS FOR CREW LAUNCH VEHICLE (CLV), CARGO LAUNCH VEHICLE (CaLV), EARTH DEPARTURE STAGE (EDS)

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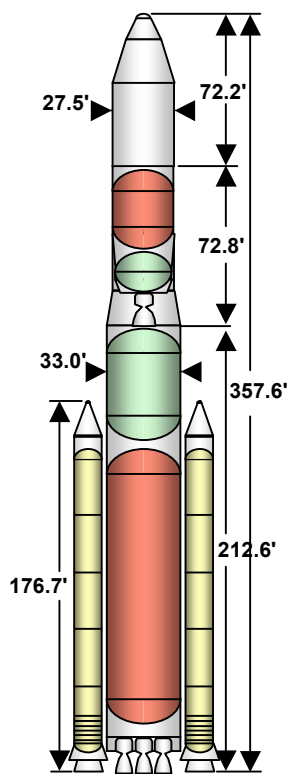
CREW LAUNCH VEHICLE (CLV) CONFIGURATION



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CARGO LAUNCH VEHICLE CONFIGURATION



Delivery Orbit	1.5 Launch TLI (EDS Suborbital Burn)
Delivery Orbit Payload	160,127 lbm 72.6 mT
Net Payload	144,114 lbm 65.4 mT
LSAM Earth liftoff	99,999 lbm 45.4 mT
CEV LEO rendezvous	44,115 lbm 20.0 mT
Insertion Altitude	78.0 nmi
T/W @ Liftoff	1.35
Max Dynamic Pressure	621 psf
Max g's Ascent Burn	3.86 g
T/W @ Booster Separation	1.36
T/W Second Stage	0.44
	Single Launch TLI (EDS Suborbital Burn)
	130,229 lbm 59.1 mT
	117,206 lbm 53.2 mT
	6.0 %

Vehicle Concept Characteristics

GLOW	7,347,875 lbf
Payload Envelope L x D	39.4 ft x 24.5 ft
Shroud Jettison Mass	12,868 lbm
Booster (each)	
Propellants	PBAN (053-06 Trace)
Useable Propellant	1,388,066 lbm
Stage pmf	0.8566
Burnout Mass	232,405 lbm
# Boosters / Type	2 / 5 Segment SRM
Booster Thrust (@ 0.7 secs)	3,484,159 lbf @ Vac
Booster Isp (@ 0.7 secs)	265.5 s @ Vac
Core Stage	
Propellants	LOX/LH2
Useable Propellant	3,091,031 lbm
Propellant Offload	0.0 %
Stage pmf	0.8989
Dry Mass	312,818 lbm
Burnout Mass	347,161 lbm
# Engines / Type	5 / RS-68
Engine Thrust (100%)	644,315 lbf @ SL 739,623 lbf @ Vac
Engine Isp (100%)	361.3 s @ SL 414.7 s @ Vac
Mission Power Level	106.0 %
Core Burn Time	327.0 sec
Second Stage / EDS	
Propellants	LOX/LH2
Useable Propellant	498,909 lbm
Propellant Offload	0.0 %
Stage pmf	0.9205
Dry Mass	36,233 lbm
Burnout Mass	42,752 lbm
# Engines / Type	1 / J-2X
Engine Thrust (100%)	293,750 lbf @ Vac
Engine Isp (100%)	450.0 s @ Vac
Mission Power Level	100.0 %
Delivery Orbit	30 x 160 nmi @ 28.5°
Gross Payload	322,443 lbm 146.3 mT
Net Payload	274,077 lbm 124.3 mT
EDS Propellant Offload	35.8 %

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ALLOY SELECTION AND EXISTING GOVERNMENT INVENTORY

2195 ALLOY HAS BEEN BASELINED FOR CREW LAUNCH VEHICLE AND CARGO LAUNCH VEHICLE.

EXISTING INVENTORY (from Space Shuttle External Tank (ET) program):

2195 Ingots:

173 ingots.

2195 Thick Plates T3M4 temper:

1.875X132X248 (78)

1.85X100X185 (30)

1.85X132X185 (27)

1.575X132X248 (137)

1.575X132X185 (71)

2195 0.548" Thin Plates :

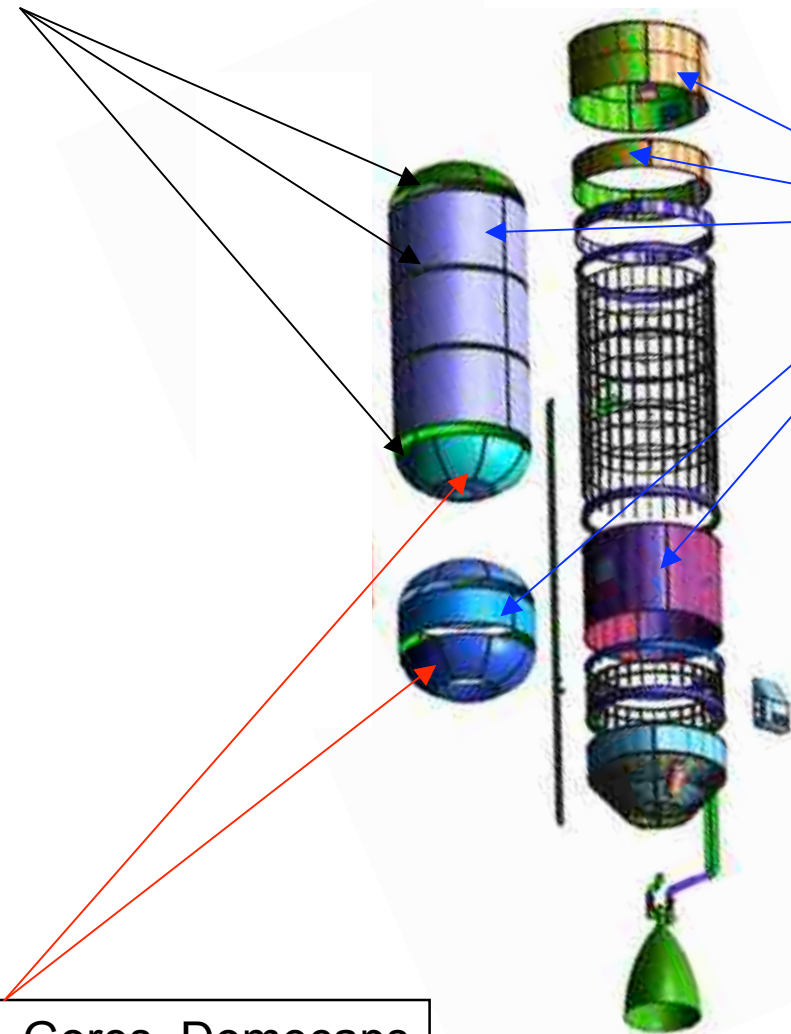
None in stock

CLV UPPER STAGE

Ingots – rings and chords

Thick Plate – Barrels,
Dry Bay structures

Thin Plate – Gores, Domecaps



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COMPONENT NEEDS FOR EACH CLV UPPERSTAGE SHIPSET

Dome caps – 8'-10' dia – 4
Dome Gores (FSW welded) – 18' nominal dia – 4
LH2 Barrels – 20' long nominal – 2
LO2 Barrel – 1
Y-rings (roll ring forging) – 4
T-rings (4 piece extrusion) – 1
Intertank – similar manufacturing to a Barrel – 1
Space Craft Adapter – 1
Interstage – Similar manufacturing to a Barrel – 1
Fwd Skirt – 1
Thrust structure skin – 1
Misc ring flanges – 10 (2 per each dry bay structure)

MATERIAL SIZES AND TEMPER NEEDS FOR EACH CLV UPPERSTAGE SHIPSET

18' diameter nominal = 680" circumference – 6 pieces per circumference – 114" wide each piece

47 ingots total per shipset or,

2 thin plates T3M2 Temper – 0.55"X101"X205" (min)

12 thin plates T"O" Temper – 0.55"X101"X260" (min)

35 thick plates T3M4 Temper – 1.85"X132"X248" (min)

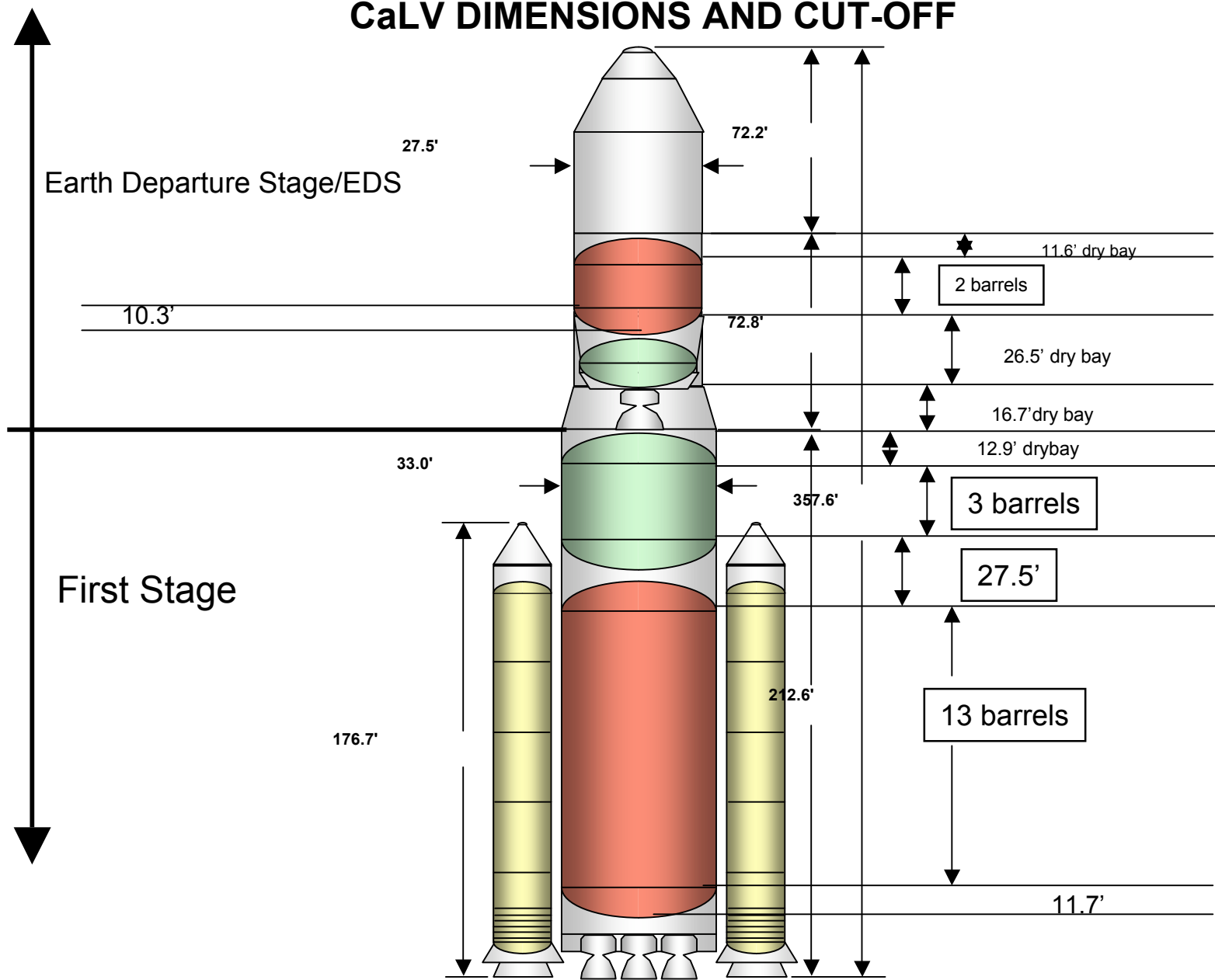
8 ingots – scalped 14.5"X55"X132

These plate sizes and thicknesses are not optimized for CLV but are based on available ET plate products. Actual plate dimensions will be established after design matures.

PRODUCT FORM, TEMPER, COMPONENTS AND MANUFACTURING

Component	Initial Temper	Final Temper	Process Restrictions
T-ring	Ingot	T8	extruded
Caps	T3M2 plate	T8	Cold spinning
Gores	TO	T8	
Barrels	T3	T8	
Y-rings	Ingot	T8	forgings

CaLV DIMENSIONS AND CUT-OFF



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EDS SHIPSET NEEDS

27.5' diameter nominal = 1037" circumference – 8 pieces per circumference – 130" wide each piece

Assumptions: 4 thin plates per ingot, 1 thick plate per ingot. Thin plate 101" wide and thick plate 132" wide. Starting tempers – T"O" for gores, T3M2 for caps, T3M4 for barrels, ingots for chords.

54.5 ingots total per shipset or,

50 thin plates T3M2/TO Temper – 101" wide (**)

38 thick plates T3M4 Temper – 132" wide (**)

4 ingots – scalped 14.5"X55"X132

**To increase material yield and reduce manufacturing can wider plates be rolled?

CaLV SHIPSET NEED

Requirement

33' diameter nominal = 1244" circumference – 10 pieces per circumference – 124.4" wide each piece

Assumptions:

4 thin plates per ingot, 1 thick plate per ingot. Thin plate 101" wide and thick plate 132" wide. Starting tempers – T"O" for gores, T3M2 for caps, T3M4 for barrels, ingots for chords/rings/flanges.

155.5 ingots total per shipset or,

58 thin plates T3M2/TO Temper – 101" wide (**)

130 thick plates T3M4 Temper – 132" wide (**)

11 ingots – scalped 14.5"X55"X132

Question:

To increase material yield and reduce manufacturing can wider plates be rolled?

MATERIAL NEEDS SUMMARY

CLV – US – 18'DIA – 47.5 INGOTS PER SHIPSET

CaLV – EDS – 27.5' DIA – 54.5 INGOTS PER SHIPSET

CaLV – FS – 33' DIA – 155.5 INGOTS PER SHIPSET

- ALL STRUCTURES ASSUME METALLIC DRY BAY STRUCTURES.
- IF SOME DRY BAY STRUCTURES ARE COMPOSITE THEN THE INGOT NEED IS REDUCED BY 30-45% OF EACH SHIPSET ABOVE.

SPECIFICATIONS

PLATE SPECIFICATION:

- FOR GORES, CAPS, AND BARRELS
- CURRENTLY WE ARE ACCEPTING AND UTILIZING ET PLATE PRODUCT FORMS
- FUTURE PLATE SPECIFICATIONS ARE NOT EXPECTED TO BE DIFFERENT FROM ET's. SIM SERVICE TEST WILL BE DIFFERENT, IF REQUIRED.
- IN THE LONG RUN Thickness x Length x Width WILL BE OPTIMIZED FOR MAXIMUM YIELD

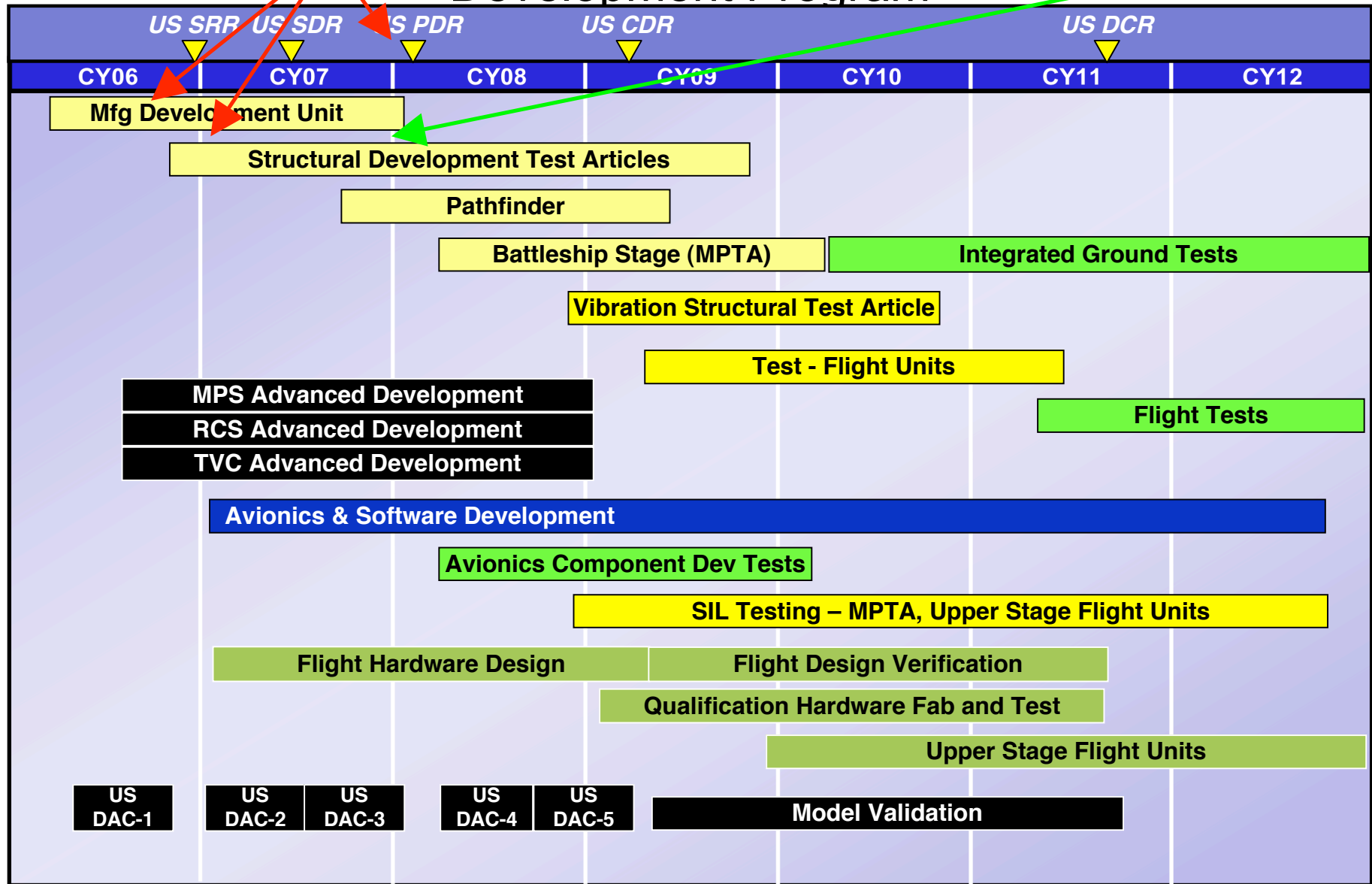
INGOT SPECIFICATION:

- FOR Y-RINGS AND T-RINGS
- CURRENT PLAN: IF AN INGOT PASSES (VENDOR INTERNAL SPEC FOR POROSITY, CHEMISTRY, H-CONTENT....) FOR ROLLING THICK PLATE THEN WE ARE DEEMING IT ACCEPTABLE FOR ROLL FORGING AND EXTRUSIONS.
- IDEAS WELCOME. FUTURE PRODUCT SPECIFIC COMPOSITIONS FEASIBLE

Material Needed in FY06
For Development Articles

CLV Upper Stage Development Program

Upper Stage Production
Contractor Online



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WHAT CAN EXISTING GOVERNMENT INVENTORY PROVIDE?

2195 Thick Plates T3M4 temper:

Several Plates with combinations of

T = 1.575" or 1.85"

W = 100" or 132"

L = 185" or 248"

Provide minimum 6 shipsets of CLV US barrels for tanks and dry bays + Development Material.
Some plates still left over.

2195 Ingots:

6 shipsets of CLV US y-rings and T-rings will need 48 ingots. 15 ingots for development.
Several ingots left over. Assume full yield.

2195 Thin Plates T3M2 or T"O" temper:

NONE Available in Existing Inventory

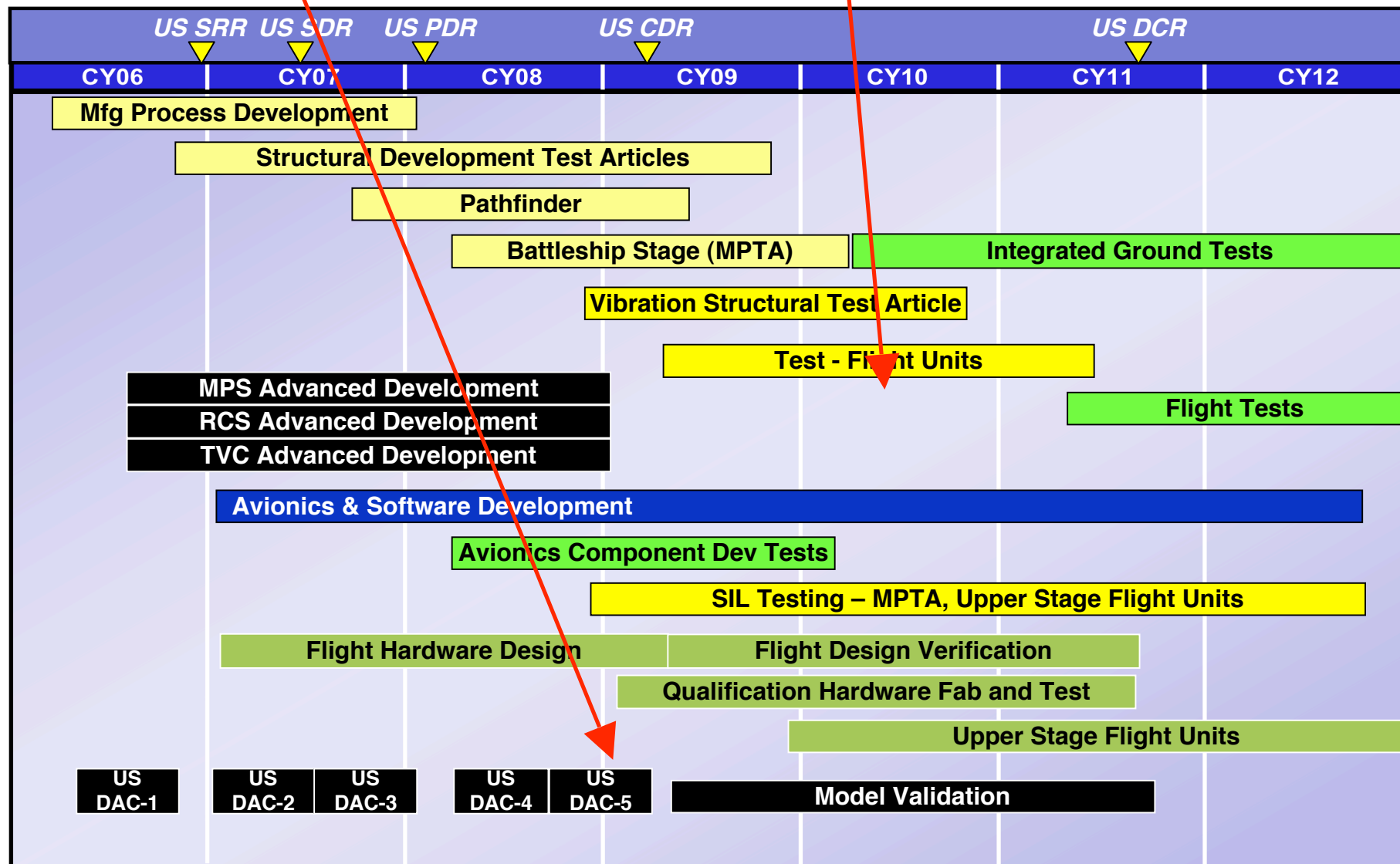
–Need:

- 6 shipsets of US dome caps and gores + Development needs: 20 T3M2 thin plates and 82 T"O" temper plates. Total 102 thin plates.
- 0.548"X101"X 274" or 294" ET thin plate product is acceptable, need it in above tempers.

–Can 10 T3M2 Thin plates and 20 T"O" Thin plates be provided in 2006 and the remainder provided in 2007?

**CONTRACTOR
PRODUCTION**

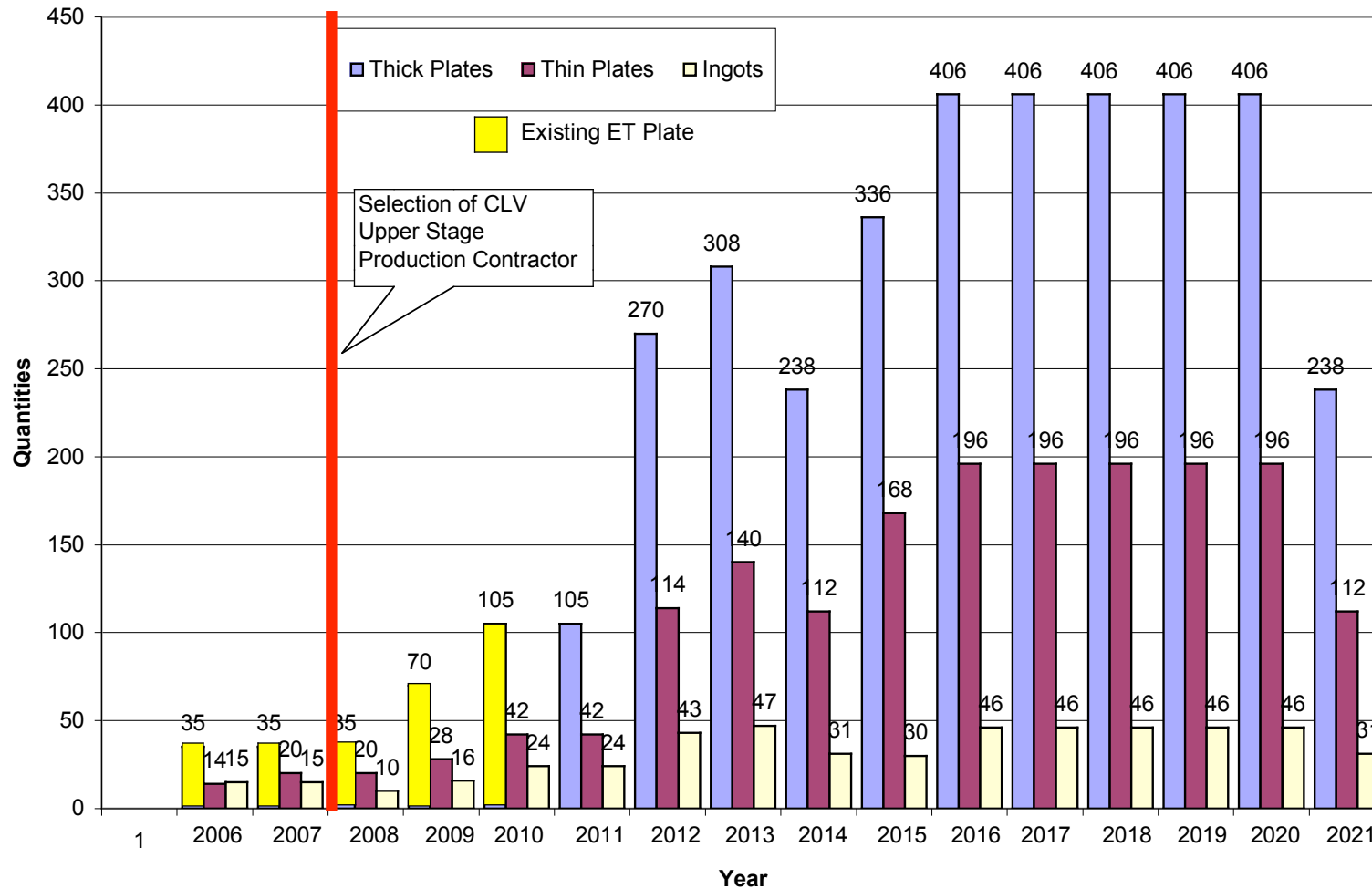
6 shipsets of material to get through testing (component fab precedes test and flight test units manufacturing). Upper Stage Requirements Only



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Aluminum Production Totals Launch Vehicle



Does not include CEV or first stage Frustum
1 CLV Flight would need 1 CEV and 1 First Stage Frustum

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